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January 25, 1993

Anne Hiller
DNREC
Division of Air and Waste Management
715 Grantham Lane
New Castle, DE 19720

RE: **Draft Work Plan For Bioremediation Treatability Testing For The Standard Chlorine of Delaware Inc., Delaware City, DE Site**

Dear Ms. Hiller:

Please find enclosed a response to the January 8, 1993 DNREC letter of comment regarding the referenced document.

Feel free to call should you have any questions.

Very truly yours,

Paul Johnston

Paul Johnston
Manager, Environmental

PJ/dm
Enclosure
pc: R. J. Touhey
K. Lose

AR307097

DRAFT WORK PLAN FOR BIOREMEDIATION TREATABILITY TESTING FOR THE STANDARD CHLORINE OF DELAWARE, INC. DELAWARE CITY, DELAWARE SITE

RESPONSE TO COMMENTS

General Comments

Item	Response

1. The potential value of developing an acclimated microbial culture to optimize treatment system effectiveness is acknowledged. An acclimation period could be used to selectively enrich for organisms capable of degrading chlorinated benzenes and/or to increase total population levels. While useful, there are two reasons why this component is not included in the present plan. The first is simply the impact on schedule for this initial screening study. Acclimation/enrichment may double the overall schedule for this project (since acclimation/enrichment would be based upon serial cultures to develop the population). The second reason is that even once such an optimized or specialized culture is developed in the laboratory, its field application may not be straightforward, particularly for in situ treatment scenarios.

   In this context, it might be noted that these treatability studies are only to screen the potential applicability of this technology, and the basic approach being taken is consistent with USEPA guidance for such studies where applicable (EPA/540/2-91/013A). The potential activity of several sources of microorganisms (site soils and wastewater treatment plant cultures) against target constituents will be screened to indicate whether such transformations are possible. Likewise, these studies will consider only "conventional" approaches to bioremediation, acknowledging that relatively more sophisticated approaches exist at research stages which could improve performance (such as the use of methanotrophic cultures cited in the work plan). Positive results from these tests will merely indicate that biological transformation of the target constituents is possible with relatively straightforward approaches. Negative or equivocal results do not necessarily preclude consideration of more innovative approaches, particularly in light of the growing body of published literature on those methods.

   The use of wastewater treatment plant biomass as a source of microbial inocula is intended to provide a broad based seed material containing high overall levels of microorganisms in the appropriate metabolic group (i.e., aerobic or anaerobic). In point of fact, if an acclimation study were to be conducted, both site soils and wastewater treatment plant biomass would likely be used as seed materials, again to increase the likelihood of encountering appropriate organisms. The preferential source for the seed materials would be an industrial WWTP receiving chlorobenzenes or related constituents. The secondary choices would be a municipal WWTP with significant industrial input.

RESPONSE TO COMMENTS
(continued)

Several candidate WWTPs are currently under consideration.

2. The comment that lower chlorinated products are generally of lower toxicity than the parent molecule, is a generalization to support the potential utility of biotransformation processes (where complete degradation cannot be obtained). As with any generalization, exceptions occur. The statement has no direct bearing on the conduct of these treatability tests. If, as a result of all treatability testing, it is determined that only transformation to lower chlorinated components can be achieved, the acceptability of the final treated matrix (in terms of toxicology or other factors) would be assessed in the RI/FS.

3. Previous experience from the SCD Remedial Investigation (RI), based upon split sampling with WESTON and USEPA laboratories, has demonstrated that data from the SCD laboratory is reliable and acceptable. Furthermore, a precedent for this being conducted solely by the SCD laboratory was established during the supplemental investigation of the effluent pipeline. Therefore, split sampling in these Treatability Tests is not considered necessary.

4. The stated sampling frequency in the test plan is intended to provide a reliable indication of potential effect of biotransformation on contaminant levels. It provides four sampling periods, biased toward the initial phase of the test, to provide an indication of the removal rate relationship, and is consistent with USEPA guidance where applicable (EPA/540/2-91/013A). (In fact, USEPA guidance allows for fewer sample intervals if study goals are met prior to completion of the full protocol.) Additional data as recommended in these comments could, of course, be useful but are not critical to the goals of this test. The additional data would, for example, provide a better estimation of kinetics than currently planned. However, these studies are not intended to provide kinetic data for use in optimization or scaleup, but rather to demonstrate that biotransformation of the target constituents is possible.

5. The range of soil samples taken for this study may provide a range of contaminant levels, a range of soil types, and/or a range of microbial cultures. These studies are not intended to elucidate which, if any, of these factors determines the success of bioremediation, but rather to screen a range of conditions to see if biotransformation occurs. If success is achieved in one or more cases, additional effort may be warranted to determine the effects

of these or other parameters and optimize the treatment scenario.

Contaminant concentration is certainly one variable which may affect performance. This test protocol provides a range of initial contaminant concentrations which may, in fact, indicate that high contaminant levels are detrimental. Since high contaminant levels exist at the site, it is useful to determine at an early stage, if such problems may exist. (It should also be recognized that the actual starting concentrations to be used for the treatability test will be somewhat lower than in the original soil samples since aqueous slurries will be used for treatability testing.)

Batch Biotransformation Testing

Item	Response

1. Separate aerobic and anaerobic tests have been planned to provide an indication of the capability of each scheme independently and in the shortest overall test schedule. Simulation of a sequential treatment process would extend the schedule of these screening tests. While this plan does not directly simulate sequential treatment, it is expected to provide an indication of whether such a simulation is warranted.

2. The comment regarding mercuric chloride is acknowledged. It should be noted that a determination has been made to use formaldehyde solution (10% by volume) rather than mercuric chloride as a inhibitor to avoid potential interference with chloride analyses.

3. The addition of nutrients to the inhibited control is acceptable. The additional nutrient amended/inoculated control is not considered critical to the goal of this test. The performance of each treatment (nutrient amended and nutrient amended/inoculated) will be assessed only in comparison to an "abiotic" (actually inhibited) control to assess whether biotransformation is occurring.

4. The selected approach uses a comparison between "biotic" (active) and "abiotic" (inhibited) treatments to assess whether biological transformation is possible. The "abiotic" control is used to correct the observed contaminant removal for all "abiotic" losses (volatilization, adsorption, photo decomposition) to permit an assessment of biologic contributions. This approach, which is consistent with USEPA guidance were applicable (EPA/540/2-91/013A) is not intended to completely distinguish among all

possible loss mechanism, but rather to assess the biological contribution. Consideration was given to employing reactors with volatile traps; however, this was considered to be infeasible for the large number of test reactors to be established. Such additional controls would be considered for subsequent testing under optimized conditions. It should be noted that chloride analyses will be conducted in an effort to demonstrate biotransformation by the production of the biological product of dechlorination (chloride).

Column Testing

Item	Response
1.	As indicated in the Work Plan, leachate from the soil column will be analyzed for chlorobenzene constituents. In addition, an effort will be made to assess chloride levels in leachate using an ion-specific electrode. These analyses are considered adequate for the intended purpose and preferable to the less specific TOX test.
2.	The recommended sampling frequency (twice weekly) is acceptable.
3.	The simulation of extended flushing periods is based upon the passage of an equivalent number of pore volumes of water (corresponding to the extended operation) through the column (based upon estimated permeability) by pressurizing the feed. This is frequently achievable in this type of test; however, as noted in the test plan, if this cannot be achieved, the test will be terminated at 60 days and performance assessed in terms of the number of pore volumes at that point.
4.	Permeability is assessed by a falling head permeability method (Army Corps. of Engineers EM-1110-21906, 30 November 1971, App.7, Permeability Tests, Section 2.2, Falling Head Test).
5.	Comment accepted. This concern is recognized in the column testing protocol. As indicated in the Work Plan, a low head space volumetric buret (gas buret) with water trap is used to collect leachate samples.